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What Has Happened to Skinner's Empirical Epistemology?

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The papers by Palmer (2013) and Schlinger (2013) center on Skinner's analysis of verbal behavior, especially those aspects of the analysis that touch on scientific and logical behavior. Skinner conceived of science as the collective activity of scientists behaving in socially coordinated ways. These collective activities are behavioral acts (observing, describing, measuring, analyzing, interpreting, etc.) that occur in context and produce consequences. Thus, scientific behavior (and its product, scientific knowledge) is itself amenable to a scientific analysis. This scientific approach to understanding science, what Skinner termed an *empirical epistemology*, can be found in several of Skinner's writings throughout his career, but it is a largely unfinished project.

The present two papers further this project by considering some functional characteristics of scientific and logical behavior inspired by a Skinnerian analysis. Schlinger reminds us of some of Skinner's most revolutionary ideas about verbal behavior and science and extends it to some troublesome terms in contemporary behavior analysis. Palmer pushes the analysis into the realm of logical and mathematical behavior, and offers a nuanced view that extends the analysis in new and important directions. I will offer some thoughts about these two interesting papers and the more general approach they represent. I will also suggest a few promising inroads for behavior analysis in the burgeoning field of science studies.

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The Roots of Radical Behaviorism

The point of departure for Schlinger's paper is Skinner's (1945) essay on operationism. Skinner's essay was in many ways a watershed event in the history of the field. Although the paper was not long (roughly eight journal pages), it was remarkable in scope. It included not only a cogent analysis of private events and self-knowledge, but also outlined an approach to science as social process that was well ahead of its time. These topics were later fleshed out in more detail, but the 1945 essay paved the way for a new type of behaviorism, what Skinner called *radical* to distinguish it from the more conventional (*methodological*) brand of behaviorism.

For many in the field of behavior analysis, the distinction between radical and methodological behaviorism turns on the problem of privacy, namely, that radical behaviorism includes privacy and methodological behaviorism excludes it. This was indeed an important dimension of the difference. But as Schlinger correctly points out, the issue of privacy was itself part of the larger issue of verbal behavior Skinner addressed in the 1945 essay.

Skinner had grown dissatisfied with traditional behavioristic approaches and their reliance on traditional language concepts. What was needed, and what he proposed in the 1945 essay, was a new formulation that approached language from a

perspective that was more consistent with an emerging empirical science of behavior than with the logic of past models. And part of what made Skinner's approach truly radical was its thoroughgoingness, a willingness to include all behavior (including our own behavior as scientists) in the account. Skinner's empirical epistemology was nothing less than applying empirical verbal behavior concepts to scientific and logical behavior.

Toward a Functional Analysis of Science

The starting point for what might be called a Skinnerian view of science is the verbal contexts of scientific activities. Schlinger's essay reminds us that what a scientific term (or any term, for that matter) means is to be found not through debate or by appeal to essences, but through an empirical examination of the conditions under which the term is used. This helped situate scientific (and logical) activity in the noisy and inherently variable world of everyday human behavior.

An implication of this approach to science is that scientific facts, concepts, models, and so on, exist as verbal responses to the world, including responses to other responses. Although direct observation is of obvious importance in science, other important parts of the scientific process occur in contexts further removed from direct observation, where verbal responses are under control not of the events themselves but of other verbal behavior about the events. As Palmer points out, this type of verbal behavior (or, more precisely, the products of such behavior in the form of words, descriptions, or models) acts as a filter, restricting the range of responses to the situation.

As we move from direct observation to increasingly more abstract verbal contexts, we filter out more and more of the details of a given situation. Whether such filtering is a good or a bad thing depends on the situation. It is usually a good thing in science. A method section in an experimental report, for example, describes the conditions surrounding an experiment but omits irrelevant details (e.g., exact dates, names of those who collected the data). Although such details are largely irrelevant to science, they may be highly relevant in other narratives, such as news stories, in which personal details are more crucial.

So, too, a data file with the number of lever presses made by a rat in an experimental chamber, or the number of academic problems completed by a child in a classroom setting, misses something gained by direct observation, but it enables the scientist to act more successfully on other aspects of the world, namely, by placing those facts in relation to other facts (e.g., comparing across sessions, conditions, and subjects) and concepts (e.g., reinforcement, stimulus control).

A major focus of Palmer's essay is on models, both empirical (the models of science) and formal (the models of logic and mathematics). Models are verbal responses to some parts of the world; partial maps that filter some parts of the world while corresponding to other parts of the world. As models become more broadly applicable, they become increasingly abstract, transcending the particular details of the situations to which they correspond. The hyperbolic function that describes choice patterns across such an impressive range of species and settings is so effective precisely because it filters out the particular details of a given experiment. Models always reflect these tradeoffs between scope and precision, and the particular choice of model depends on which aspects are more important for particular purposes.

Even greater levels of abstraction are approached by formal models, which in the extreme, relate only to other verbal behavior (e.g., syllogisms

and other verbal frames of deductive logic). Unlike empirical models, such as hyperbolic discounting, with links to the nonverbal world, the formal models of logic and mathematics link only to other verbal behavior. A major challenge for an empirical account such as Skinner's is to account for the origins and maintenance of these formal (what Palmer calls *essentialistic*) models that are seemingly indifferent to the nonverbal world. Skinner's move here was to include such formal modeling in his empirical account of verbal behavior.

Palmer elaborates Skinner's approach, using the concept of verbal framing as a starting point. The ability to manipulate the symbols in a mathematical expression, or the terms in a syllogism, depends on the prior establishment of relational autoclitic frames (what others might call frames of coordination or equivalence). Through repeated experience with relational terms, verbal frames are established that permit relatively open-ended expansion. Some of these verbal frames are especially relevant to the background skills of science and logic, but Skinner's key insight here was that scientific and logical behavior is continuous with other aspects of experience. It does not take place in some logical-theoretical realm that transcends everyday life, but is instead part of everyday human contexts, messy and variable as they may be.

In a broad-based empirical verbal behavior framework, even essentialistic models therefore have functional roots. When one gets down to analyzing the actual behavior involved, both empirical and formal modeling involve many of the same verbal frames (e.g., equivalence, coordination, causality, to name a few). There is a kind of logic of sound experimental design, for example, that involves frames of *quantity comparisons*, *causality*, *sequential comparisons*, and so on. Although formal and empirical models may differ with respect to the specific frames they recruit, they also have much in common: They are classes of verbal responses with overlapping sources of stimulus control. In grounding both types of models in a more general account of verbal behavior, Palmer provides a plausible natural-science account of essentialistic modeling as behavior.

It is also worth noting that Palmer's account is broadly consistent with recent work in field of complex stimulus control (e.g., stimulus equivalence, relational frame theory) in emphasizing the development of generalized frames, established through reinforcement, but applicable to an almost endless variety of forms. The area is thus ripe for conceptual as well as empirical development.

Schlinger's essay reminds us of Skinner's strongly pragmatic approach to science, and in so doing, also raises important research questions. According to Skinner, scientific progress is defined in relation to successful prediction and control of behavior. When applied to experimental data under controlled conditions, these terms can be understood in a fairly straightforward manner. But how are they to be applied in the conceptual realm? What do prediction and control mean when evaluating competing accounts of privacy or rule-governed behavior, for example? Unless, or until, such accounts can be teased apart empirically, they will have to be evaluated in terms of their coherence or consistency with the broader conceptual frames in which they participate (i.e., by appeal to other verbal behavior rather than to direct prediction and control of nonverbal behavior). But what is meant by *consistency* with a conceptual framework? Where does it come from, and what maintains it? These are important empirical questions, but to date, we know relatively little about the kinds of verbal relations involved here.

Toward a Science of Science

A functional analysis of verbal behavior has grown substantially in the years since the publication of Skinner's (1945) paper, yet the empirical epistemology Skinner envisioned has been slower to develop. For one thing, it has had to wait on an empirical analysis of verbal behavior. Promising gains have been made over the past few decades in the experimental analysis of human behavior, including verbal behavior. Studies of rule following, problem solving, analogical reasoning, cooperation, abstraction, causality, and so on, are relevant to the analysis, providing a better understanding of the individual components that comprise scientific repertoires (e.g., Hayes, Barnes-Holmes, & Roche, 2001; Horne & Lowe, 1996; Sidman, 1994, 2009; Urcuioli, 2013; Wasserman & Young, 2010; Zentall, Galizio, & Critchfield, 2002).

Some of this work has been done in behavior analysis, but there are rich and expanding empirical literatures in other complementary disciplines that bear importantly on a scientific analysis of science (Barrett, 2011; Chemero, 2009; Wilson & Golonka, 2013). The approaches most compatible with behavior analysis fall within the broad rubrics of situated or embedded cognition, according to which perception and cognition are viewed as acts in context rather than mental states that underlie them. Much of the work in this domain broadly encompasses ecological approaches to perception and cognition, some emanating from J. J. Gibson, whose affinities with behavior analysis have been recognized for some time (e.g., Costall, 1984; Morris, 2009). As we learn more about these skills and how they develop in social contexts, we will learn more about how they combine in scientific practices and in the generation of scientific knowledge.

In the philosophical domain, there are several lines of work closely compatible with Skinner's view on science, including Noë's externalist philosophy of science, in which consciousness in viewed as extended activity between person and environment (Rachlin, 2012); Heft's ecological approach to psychology, in which perception and cognition are viewed as unmediated acts in context (Morris, 2009); Giere's realist approach to science, in which scientific models are construed as verbal maps of the world (Hackenberg, 2009); connectionist models of adaptive learning, in which adaptive behavior and cognition arise from simpler forms (Donahoe & Palmer, 1989); and Rorty's pragmatic philosophy, in which truth is defined in terms of successful working (Leigland, 1999).

Despite the common ground shared with other viewpoints, Skinner's views on science have had little impact outside behavior analysis. Although the present essays provide useful extensions of the basic Skinnerian approach, the analysis would also benefit greatly by broadening its scope, situating it in relation to other compatible frameworks. This would not only help illuminate the rich empirical tradition behavior analysis shares with other viewpoints, it may also shed light on the uniqueness of behavior analysis, that is, what it has to offer to the broader field of science studies. The field of science studies is at present an interdisciplinary and rather eclectic mix of perspectives and methods, including history of science, philosophy of science, and sociology of science. It needs more *science* of science, especially the type of behavioral science informed by Skinner's empirical analysis of language. Advances in these areas would help to further the empirical epistemology envisioned by Skinner and other scientific approaches to science.

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